REMARKS/ARGUMENTS

Favorable reconsideration of this application as presently amended and in light of the following discussion is respectfully requested.

Claims 1-8, 11-16, 18-19 and 22-37 are presently active in this case, Claims 1, 11-12, 14, 18-19 and 26 amended and Claims 10, 20-21 and 38 canceled by way of the present amendment.

In the outstanding Office Action, Claims 1-8 and 10-38 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Publication 2003/0143328 to Chen et al. in view of WO 03/021002 to Strang.

First, Applicant wishes to thank Examiner Turocy for the June 27, 2007 discussion at which time amendments and arguments substantially as indicated herein were presented. While no agreement was reached, Examiner Turocy indicated that the amendments and arguments presented will move this case closer to allowance, but full consideration is needed.

Turning now to the merits, in order to expedite issuance of a patent in this case, Applicant has amended independent Claims 1 and 26 to clarify the patentable features of the present invention over the cited references. Specifically, Applicant's Claim 1, as amended, recites an atomic layer deposition system comprising a process chamber, a substrate holder provided within the process chamber and configured to support a substrate and an oscillator coupled to the substrate holder and producing an RF signal at a first power level that ignites a plasma. An amplifier is coupled to the oscillator and configured to periodically increase the first power level to a second power level in order to improve conformal coating of high aspect ratio features in the substrate. Also recited is a gas injection system including a first gas supply that supplies a first precursor through a mass flow controller to the process chamber, the first precursor selected from the group consisting of WF_6, $W(CO)_6$, $TaCl_5$, PDEAT (pentakis(diethylamido) tantalum), PEMAT (pentakis(ethylmethylamido)

tantaluum), $TaBr_5$, TBTDET (t-butylimino tris(diethylamino) tantalum), molybdenum hexafluoride, Cu(TMVS)(hfac), (Trimethylvinylsilyl) hexafluoroacetylacetonato Copper I, CuCl, $Zr(NO_3)_4$, $ZrCl_4$, $Hf(NO_3)_4$, $HfCl_4$, niobium pentachloride, zinc dichloride, $Si(NO_3)_4$, $SiCl_4$, dichlorosilane, $Ti(NO_3)$, $TiCl_4$, TiI_4, tetrakis(diethylamino)titanium, tetrakis(dimethylamino)titanium, aluminum trichloride, trimethylaluminum, gallium nitrate, trimethylgallium, and Cr oxo-nitrate. The claimed gas injection system also includes a second gas supply that supplies a second precursor through a pulsed injection manifold to the process chamber, the second precursor including at least one of H_2, N_2, O_2, H_2O, NH_3, or H_2O_2. Further, a controller is configured to control the mass flow controller to continuously flow the first precursor to the process chamber and to control the pulsed injection manifold pulse the second precursor to the process chamber at a first time such that the second precursor reacts with the first precursor to deposit a monolayer on the substrate, the controller being configured to pulse RF power from the oscillator to the substrate holder, to the second power level at a second time in order to improve conformal coating of the monolayer on high aspect ratio features in the substrate.

Thus, Applicant's independent Claim 1 has been amended to recite details of the atomic layer disposition (ALD) system, and specific first precursors and second precursors used in an ALD process performed on the ALD system. Further, Applicant's Claim 1 now recites that the oscillator produces an RF signal at a first power level that ignites a plasma, and an amplifier coupled to the oscillator to periodically increase the first power level to a second power level in order to improve conformal coating of high aspect ratio features of the substrate. Also recited is that the second power level improves conformal coating of the monolayer on high aspect ratio features in the substrate. Independent Claim 26 has been similarly amended to include these features in method claim format. For example, as seen in Figure 2 of Applicant's specification, the RF power 130 is provided at a first power level 134

that is sufficient to maintain a plasma, and periodically increased to a second power level 132 during a pulse period 138 in order to improve conformal coating in an ALD process.[1]

In contrast, the cited reference to Chen et al. discloses a plasma enhanced deposition system wherein the plasma is created adjacent to a processing region where a substrate is processed. As seen in Figure 2 of Chen et al., the apparatus includes a top shower plate 160 and a bottom shower plate 170, and an RF power source 190 applies RF power to the top and/or bottom shower plate in order to generate a plasma between the shower plates. The plasma then diffuses into the processing region above the substrate holder. Paragraph [0042] of Chen et al. also mentions that a substrate support 112 can be powered or grounded to provide a plasma between the bottom shower plate 170 and the substrate support 112.

However, there is no teaching in Chen et al. of providing a first power level on a substrate holder to ignite a plasma, and periodically pulsing by increasing the first power level to a second power level that enlarges a sheath thickness of the plasma in order to improve conformality of the ALD process. In fact, Applicant maintains that Chen et al. does not disclose pulsing power on the substrate holder at all. The general statement in paragraph [0042] of the capability of applying power to a substrate holder is not a sufficient teaching for providing pulsed power on the substrate holder as required by Applicants' claims. More specifically, this general teaching is in conflict with the specific teachings of Figures 6, 7, 9 and 10, and paragraphs [0055], [0066] and [0088], respectively, which show and disclose that the RF power is applied to a top shower head and/or a bottom shower head. That is, there is no specific teaching of pulsing RF power on a substrate holder in Chen et al. Further, Chen et al. does not mention improving conformal coating of high aspect ratio features in the substrate as also required by Claims 1 and 26.

[1] See Applicants' specification at paragraph [0018] and Figure 2.

With regard to the secondary reference to Strang, this reference is directed to an etching process whereby a CF_x reactants chemically etch the surface of the substrate while positively charged ions such as Ar^+ provide energy to catalyze the surface reactions.[2] As discussed in the June 27th discussion, Strang briefly mentions improving chemical transport in a deposition system. However, teachings in the prior art must be enabling in order to be applied in a rejection. Applicant submits that the vague mention of deposition in Strang in the context of detailed etch discussions is not sufficient to teach application of any teachings in Strang to an ALD process. There is no discussion of an ALD process in Strang, let alone the specific ALD components and gases now recited in Claims 1 and 26 to clarify the ALD nature of the claimed process.

Finally, Applicants submit that even if all limitations of amended Claims 1 and 26 can be said to exist in the combination of Chen et al. and Strang, it would not be obvious to combine these references to arrive at the claimed invention. As discussed above, increasing the RF power and the substrate holder from a first level to a second level in conjunction with pulsing of a second process gas provides the advantage of improving conformality of deposition within high aspect ratio features using the ALD process.[3] It is Applicants who discovered this advantage. One of ordinary skill in the art would not predict that applying the gas and RF power pulsing techniques of Strang to the general ALD teaching of Chen et al. would result in some advantage for the ALD process. Indeed, Chen et al. provides an ALD process in the context of a very specific chamber structure having a top and bottom shower plate for generating a plasma therebetween. There is no indication in the cited references, and the Office Action does not support the notion that pulsing RF power on the substrate holder of Chen et al. will provide improved conformality of an ALD process performed in the unique system having a plasma generally contained within top and bottom shower plates.

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[2] See Strang at paragraphs [0003] and [0034].
[3] See Applicants' specification at paragraphs [0017] and [0018].

Therefore, Applicants' Claims 1 and 26 patentably define over the cited references. Moreover, as Claims 2-8, 10-19 and 22-37 depend from Claims 1 or 26, these claims also patentably define over the cited references.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application and the present application is believed to be in condition for formal allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

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